CLAIMS

What is claimed is:

1. A partial oxidation catalyst comprising:

a catalytic metal useful for catalyzing a partial oxidation reaction and a porous support material;

wherein the partial oxidation catalyst includes a plurality of discrete structures, each comprising a core containing said porous support material and an outer region disposed on said core;

wherein the plurality of discrete structures has an average size greater than 0.5 mm;

wherein the outer region has a thickness of not more than 200 microns, and further wherein more than 60% of the catalytic metal loaded on the discrete structure is located in the outer region.

2. The partial oxidation catalyst according to claim 1 wherein the catalytic metal comprises a Group VIII metal or noble metal.

3. The partial oxidation catalyst according to claim 1 wherein the catalytic metal comprises rhodium.

4 The partial oxidation catalyst according to claim 3 wherein the catalytic metal comprises about 1 wt % or less of the total catalyst weight.

5. The partial oxidation catalyst according to claim 3 wherein the catalytic metal comprises about 0.75wt % or less of the total catalyst weight.

6. The partial oxidation catalyst according to claim 3 wherein the catalytic metal comprises about 0.5wt % or less of the total catalyst weight.

7. The partial oxidation catalyst according to claim 3 wherein the catalyst further comprises a promoter selected from lanthanide metals, rhenium, zirconium, and combinations.

8. The partial oxidation catalyst according to claim 1 wherein the catalyst further comprises a promoter, and more than 60% of the promoter loaded on the discrete structure is located in the outer region.

9. The partial oxidation catalyst according to claim 1 wherein 80% of the catalytic metal is located within the outer region.

10. The partial oxidation catalyst according to claim 1 wherein the outer region thickness is no greater than 100 microns.

11. The partial oxidation catalyst according to claim 1 wherein the support material comprises a refractory material selected from the group consisting of alumina, titania, zirconia, Ga_2O_3, silica and mixtures thereof.

12. The partial oxidation catalyst according to claim 1 wherein the support material comprises alumina.

13. A process for producing synthesis gas comprising:

passing a hydrocarbon containing gas and an oxygen containing gas over a partial oxidation catalyst, under conditions effective to produce a gas stream comprising hydrogen and carbon monoxide,

wherein the partial oxidation catalyst comprises a catalytic metal and a support material;

wherein the partial oxidation catalyst includes a plurality of discrete structures, each comprising a core containing said support material and an outer region disposed on said core;

wherein the plurality of discrete structures has an average size greater than 0.5 mm;

wherein the outer region has an thickness of not more than 200 microns, and further

wherein more than 60% of the catalytically active metal loaded on the discrete structure is located in the outer region.

14. The process according to claim 13 wherein the catalytic metal comprises a Group VIII metal or noble metal.

15. The process according to claim 13 wherein the catalytic metal comprises rhodium.

16. The process according to claim 15 wherein the catalytic metal comprises about 1 wt % or less of the total catalyst weight.

17. The process according to claim 15 wherein the catalytic metal comprises about 0.75wt % or less of the total catalyst weight.

18. The process according to claim 13 wherein 80% of the catalytic metal is located within the outer region.

19. The process according to claim 13 wherein the outer region thickness is no greater than 100 microns.

20. The process according to claim 13 wherein the support material comprises alumina.

21. The process according to claim 13 wherein the partial oxidation catalyst exhibits a methane conversion of greater than or equal to 80 mole %.

22. The process according to claim 13 wherein the partial oxidation catalyst exhibits a hydrogen selectivity of greater than or equal to 80 mole %.

23. The process according to claim 13 wherein the partial oxidation catalyst exhibits a carbon monoxide selectivity of greater than or equal to 80 mole %.

24. The process according to claim 13 wherein the hydrocarbon containing gas and an oxygen containing gas over the catalyst is done at a GHSV greater then 100, 000 hr^{-1}.

25. The process according to claim 13 wherein the hydrocarbon containing gas comprises methane.

26. A hydrocarbon gas to liquid conversion process comprising:

(a) passing a hydrocarbon containing gas and an oxygen containing gas over a partial oxidation catalyst, under conditions effective to produce a gas stream comprising hydrogen and carbon monoxide,

(b) reacting at least a portion of the gas stream from step (a) in a hydrocarbon synthesis reactor under conditions effective to produce liquid hydrocarbons;

wherein the partial oxidation catalyst comprises a catalytic metal and a support material;

wherein the partial oxidation catalyst includes a plurality of discrete structures, each comprising a core containing said support material and an outer region disposed on said core;

wherein the plurality of discrete structures has an average size greater than 0.5 mm;

wherein the outer region has an thickness of not more than 200 microns, and further

wherein more than 60% of the catalytically active metal loaded on the discrete structure is located in the outer region;

27. The process according to claim 26 wherein the catalytic metal comprises a Group VIII or noble metal.

28. The process according to claim 26 wherein the catalytic metal comprises rhodium.

29. The process according to claim 28 wherein the catalytic metal comprises about 1 wt % or less.

30. The process according to claim 25 wherein 80% of the catalytic metal is located within the outer region.

31. The process according to claim 25 wherein the support material comprises alumina.

32. The process according to claim 26 wherein the hydrocarbon synthesis reactor is a Fischer-Tropsch reactor.

33. A method for preparing a catalyst particle having a core and an exterior surface, the method comprising:

(a) providing a porous support material in the form of a particle having an outer surface;

(b) selectively depositing a catalytic material on the support material such that at least 60% of the deposited catalytic material is disposed within the smaller of, by volume,

(i) the outer 200 μm as measured from the catalyst particle's exterior surface, or

(ii) the outer 30% of the catalyst volume; and

(c) calcining the support and deposited catalyst material to form the catalyst particle.

34. The method according to claim 33 wherein step (b) comprises at least one of the following techniques:

(1) preferential deposition at the outer surface of the support material, and

(2) pore blocking of the porous support material.

35. The method according to claim 33 wherein step (b) comprises preferential deposition of the catalyst material at the outer surface of the support material.

36. The method according to claim 35 wherein the preferential deposition comprises impregnating the catalyst material onto the support using a low vapor pressure solvent.

37. The method according to claim 36 wherein the low vapor pressure solvent is an organic solvent.

38. The method according to claim 37 wherein the low vapor pressure solvent is an alcohol.

39. The method according to claim 33 wherein step (b) comprises pore blocking of the porous support material.

40. The method according to claim 39 wherein the pore blocking is carried out by:

(1) applying a pore-blocking agent to porous support material so as to block substantially all of the pores of the porous support material and to form a core of the catalyst particle; and

(2) applying a precursor of a catalytic material to said core so as to form a catalyst precursor with an outer region disposed on said core, and wherein said outer region comprises at least 60% of the applied catalytic material.

41. The method of claim 33 wherein the catalytic material comprises a Group VIII metal or a noble metal.

42. The method of claim 40 wherein the application of the pore-blocking agent comprises impregnating the support particle with silicic acid or sodium carbonate.

43. The method of claim 40 wherein the pore blocking agent comprises silicic acid or sodium carbonate.